UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way N.E., Bldg. 1
Seattle, WA 98115

Refer to NOAA Fisheries No:
2002/00948

September 21, 2004

Mr. Lawrence C. Evans
Portland District, Corps of Engineers
CENWP-OP-GP (Mr. Ron Marg)
P.O. Box 2946
Portland, Oregon 97208-2946

Re: Endangered Species Act Interagency Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Fort James Water Intake, Columbia River Basin, Clatsop County, Oregon (Corps No.: 200200420)

Dear Mr. Evans:

Enclosed is a biological opinion and conference opinion (Opinion) prepared by NOAA's National Marine Fisheries Service (NOAA Fisheries) pursuant to section 7 of the Endangered Species Act (ESA) on the effects of the proposed Fort James water intake in Clatsop County, Oregon. In this Opinion, NOAA Fisheries concludes that the proposed action is not likely to jeopardize the continued existence of thirteen species of ESA-listed and proposed salmonid fishes, Snake River (SR) fall-run Chinook salmon, SR spring/summer-run Chinook salmon, SR sockeye salmon, SR steelhead, Lower Columbia River (LCR) Chinook salmon, Upper Columbia River (UCR) spring-run Chinook salmon, Upper Willamette River (UWR) Chinook salmon, Columbia River chum salmon, Middle Columbia River steelhead, LCR steelhead, UWR steelhead, UCR steelhead, and LCR coho salmon (proposed for listing), or destroy or adversely modify designated critical habitat. As required by section 7 of the ESA, NOAA Fisheries included reasonable and prudent measures with non-discretionary terms and conditions that are necessary to minimize the effects of incidental take associated with this action. However, the incidental take statement does not become effective for LCR coho salmon until NOAA Fisheries adopts this conference opinion as a biological opinion, after the listing is final. Until the time that proposed species are listed, the prohibitions of the ESA do not apply.

This document also serves as consultation on essential fish habitat pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations (50 C.F.R. Part 600). NOAA Fisheries concluded that the proposed action may adversely affect designated EFH for Pacific salmon, groundfish and coastal pelagic species. As required by section 305(b)(4)(A) of the MSA, included are conservation recommendations that NOAA Fisheries believes will avoid, minimize, mitigate, or otherwise offset adverse effects on

EFH resulting from the proposed action. As described in the enclosed consultation, 305(b)(4)(B) of the MSA requires that a Federal action agency must provide a detailed response in writing within 30 days after receiving an EFH conservation recommendation.

If you have questions regarding this consultation, please contact Robert Anderson, Fisheries Biologist in the Oregon Coast/Lower Columbia River Habitat Branch of the Oregon State Habitat Office at 503.231.2226.

Sincerely,

for Michael R Crouse

D. Robert Lohn
Regional Administrator

Endangered Species Act – Section 7 Consultation
Biological Opinion and Conference Opinion

&

Magnuson-Stevens Fishery Conservation and Management Act
Essential Fish Habitat Consultation

Fort James Water Intake, Columbia River Basin, Clatsop County, Oregon
(Corps No.: 200200420)

Lead Action Agency:	United States Army Corps of Engineers
Consultation Conducted By:	NOAA's National Marine Fisheries Service, Northwest Region
Date Issued:	September 21, 2004
Issued by:	for Michael R Crouse ____________________ D. Robert Lohn Regional Administrator

NOAA Fisheries No.: **2002/00948**

TABLE OF CONTENTS

INTRODUCTION 1
Background and Consultation History 1
Proposed Action 2
Conservation Measures 3
Action Area 3

ENDANGERED SPECIES ACT 3
Status of the ESUs 4
Environmental Baseline 17
Effects of the Action 18
Cumulative Effects 24
Conclusion 24
Reinitiation of Consultation 25
Incidental Take Statement 25
Amount or Extent of Take 25
Reasonable and Prudent Measures 26
Terms and Conditions 27

MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT 31
EFH Conservation Recommendations 32
Statutory Response Requirement 32
Supplemental Consultation 32

DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW 33

LITERATURE CITED 35

INTRODUCTION

This document prepared by NOAA's National Marine Fisheries Service (NOAA Fisheries) includes a biological opinion (Opinion) and incidental take statement in accordance with section 7(b) the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531, et seq.), and implementing regulations at 50 C.F.R. 402. As a result of an August 6, 2004, decision by the Ninth Circuit Court of Appeals (*GiffordPinchot Task Force et al. v. U.S. Fish and Wildlife Service*), which ruled that the regulatory definition of destruction or adverse modification of critical habitat is flawed, NOAA Fisheries will rely on the ESA statutory requirement, at 16 U.S.C. 1536(a)(4), for its critical habitat analysis. The essential fish habitat (EFH) consultation was prepared in accordance with section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801 *et seq*.) and implementing regulations at 50 C.F.R. 600. The administrative record for this consultation is on file at the Oregon Coast/Lower Columbia Habitat Branch in Portland, Oregon.

Background and Consultation History

On August 6, 2002, NOAA Fisheries received a letter from the U.S. Army Corps of Engineers (Corps) requesting formal consultation pursuant to section 7(a)(2) of the ESA, and EFH consultation pursuant to section 305(b)(2) of the MSA for the proposed Fort James water intake, Clatsop County, Oregon. A biological assessment (BA) describing the proposed action its potential effects was submitted with the letter. NOAA Fisheries responded to the Corps with a letter dated August 29, 2002, indicating that we did not have sufficient information to evaluate the effects of the proposed action on ESA-listed species, designated critical habitat, and EFH.

On March 31, 2003, NOAA Fisheries received a letter from the Corps with a revised application and an addendum to the biological assessment, but did not provide all of the information requested in our August 29, 2002, letter. On April 16, 2004,[1] NOAA Fisheries and the Corps agreed to proceed with the consultation without the requested information. On July 19, 2004, NOAA received information from the applicant's council that the new water intake supply pipe did not have the capacity to withdraw more than 125 cubic feet of water per second (cfs). On July 28, 2004, NOAA received a revised project description from the Corps.

In the letter, the Corps determined the proposed action was likely to adversely affect the Snake River (SR) fall-run Chinook salmon, SR spring/summer-run Chinook salmon, SR sockeye salmon, SR steelhead, Lower Columbia River (LCR) Chinook salmon, Upper Columbia River (UCR) spring-run Chinook salmon, Upper Willamette River (UWR) Chinook salmon, Columbia River (CR) chum salmon, Middle Columbia River (MCR) steelhead, LCR steelhead, UWR steelhead, UCR steelhead, and LCR coho salmon (proposed for listing), and designated critical habitat for SR spring/summer Chinook salmon, SR fall-run Chinook salmon, and SR sockeye salmon. The Corps also found the proposed actions may adversely affect designated EFH.

---

[1] Phone conversation between Don Borda, U.S. Army Corps of Engineers, and Robert Anderson, NOAA Fisheries, April 16, 2004.

Proposed Action

For purposes of this consultation, the proposed action is the issuance of permits by the Corps under section 404 of the Clean Water Act and section 10 of the Rivers and Harbors Act to the Fort James Corporation to construct a new water intake structure. The purpose of the project is to replace the existing water intake structure with a new one that is compliant with NOAA Fisheries juvenile fish screening criteria.

The Fort James Corporation is proposing to relocate and replace an existing water intake structure. The new water intake structure would be designed so that the maximum approach velocity would not exceed 0.4 feet per second (fps), have an auto differential setting of 0.1 feet, screen slot openings of 1.75 millimeters, effective open area not less that 50%, and a maximum top-of-screen submergence depth of 25 feet.

The existing water intake supply pipe is 72 inches in diameter and would be replaced with a 100-foot long by 72-inch diameter pipe approximately 40 feet upriver of the existing water intake structure. The water intake supply pipe would be fitted with a modified tee-screen structure. The tee-screen structure would be supported by an unspecified number of steel H-piles (intake support frame). The water intake supply pipe would be locate the top of the tee-screen structure at an elevation of -8.0 mean sea level (MSL). The Fort James Corporation proposes to install 10 to 12 hollow steel piles. Pile would be used to support the new tee-screen structure and for the construction of one new dolphin pile upriver.

Installation of the water intake supply pipe would require a temporary 24-foot wide by 111-foot long steel sheet pile cofferdam that would extend from the pump station to approximately 55 feet into the Columbia River from top-of-bank. The area within the cofferdam would not be de-watered. Once the cofferdam is in place, the riverbank and riverbed would be excavated for installation of the water intake supply pipe. Excavation would occur from top-of-bank. Approximately 1,403 cubic yards of material would be excavated from within the cofferdam. The toe of the excavation would extend from approximately an elevation of -14.0 MSL near the pump station to an elevation of -18.0 MSL at the intake structure. Approximately 2 feet of pipe bedding (rock) would be placed under the 72-inch water intake supply pipe.

Excavated materials would be stockpiled at the upland site near the pump station. Final grading would include reinstating excavated materials, placement of riprap, reseeding, and replanting. Approximately 113 cubic yards of excess excavated materials would be disposed of at an upland location at the mill. Once final grading is completed, the cofferdam would be removed.

Once the cofferdam is removed, the tee-screen structure would be installed and attached to the water intake supply pipe. The new water intake would connect to the wet well of the existing water supply pump station. To facilitate installation of the new water intake screen system and installation of the dolphin piles, the Fort James Corporation proposes to use a barge for over-water work, where required.

The project would require 1,209 cubic yards of fill (riprap and sand). The existing intake pipe would be left in place, and an existing 6-foot gate valve would be shut preventing intake of water through this pipe.

Conservation Measures

NOAA Fisheries regards the conservation measures included in the consultation request (BA p. 31) as useful and important to reduce adverse effects to salmon, steelhead, and designated critical habitat, and considers them to be an integral part of the proposed action. Conservation measures in the following categories would apply (see consultation proposal for details): (1) Timing (November 1 to February 28), (2) temporary erosion and sedimentation control, (3) hazardous materials containment, and (4) vegetation replanting.

Action Area

The action area means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 C.F.R. 402.02). For purposes of this consultation, the action area is defined as an area (arc) measuring 1946 feet from the left bank of the Columbia River at river mile 42.45, and includes all upland areas measuring 500 feet landward from the mean high high tide (MHHT) elevation. The action area is used by juvenile and adult salmon and steelhead (Table 1), and the riverbed and adjacent riparian zone within 300 feet of MHHT elevation is designated critical habitat for SR spring/summer Chinook salmon, SR fall-run Chinook salmon, and SR sockeye salmon, and is designated EFH for Chinook salmon, coho salmon (PFMC 1999), and starry flounder (PFMC 1998a).

ENDANGERED SPECIES ACT

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat on which they depend. Section 7(a)(2) of the ESA requires Federal agencies to consult with U.S. Fish and Wildlife Service and NOAA Fisheries, as appropriate, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their critical habitats. Section 7(b)(4) requires the provision of an incidental take statement specifying the impact of any incidental taking and specifying reasonable and prudent measures to minimize such impacts.

Biological and Conference Opinion

This Opinion presents NOAA Fisheries' review of the status of each evolutionarily significant unit (ESU)[2] considered in this consultation, the condition of designated critical habitat, the environmental baseline for the action area, all the effects of the action as proposed, and cumulative effects [50 C.F.R. 402.14(g)]. For the jeopardy analysis, NOAA Fisheries analyzes those combined factors to conclude whether the proposed action is likely to appreciably reduce the likelihood of both the survival and recovery of the affected ESA- listed species. For the critical habitat, Congress said that 'destruction or adverse modification' could occur when sufficient critical habitat is lost so as to threaten a species' recovery even if there remains sufficient critical habitat for the species' survival. If the action under consultation is likely to jeopardize the continued existence of an ESA-listed species, or destroy or adversely modify critical habitat, NOAA Fisheries must identify any reasonable and prudent alternatives for the action that avoid jeopardy or destruction or adverse modification of critical habitat and meet other regulatory requirements (50 C.F.R. 402.02).

Status of the ESUs

This section defines range-wide biological requirements of each ESU, and reviews the status of the ESUs relative to those requirements. The present risk faced by each ESU informs NOAA Fisheries' determination of whether additional risk will 'appreciably reduce' the likelihood that an ESU will survive and recover in the wild. The greater the present risk, the more likely any additional risk resulting from the proposed action's effects on the population size, productivity (growth rate), distribution, or genetic diversity of the ESU will be an appreciable reduction (McElhaney *et al.* 2000).

<u>SR Fall Chinook Salmon</u>
The SR fall Chinook salmon ESU once spawned in the mainstem of the Snake River from its confluence with the Columbia River upstream to Shoshone Falls (RM 615). The spawning grounds between Huntington (RM 328) and Auger Falls (RM 607) were historically the most important for this species. Only limited spawning activity occurred downstream from RM 273 (Waples *et al.* 1991a), about one mile below Oxbow Dam (Waples *et al.* 1991a). However, irrigation and hydropower projects on the mainstem Snake River have inundated, or blocked access to, most of this area in the past century. The construction of Swan Falls Dam (RM 458) in 1901 eliminated access to much of this habitat and the completion of Brownlee Dam in 1958 (RM 285), Oxbow Dam in 1961 (RM 272), and Hells Canyon Dam in 1967 (RM 247) blocked access to the rest.

---

[2] 'ESU' means an anadromous salmon or steelhead population that is either listed or being considered for listing under the ESA, is substantially isolated reproductively from conspecific populations, and represents an important component of the evolutionary legacy of the species (Waples 1991). An ESU may include portions or combinations of populations more commonly defined as stocks within or across regions.

Since 1991, spawning has been limited primarily to the mainstem Snake River between a point upstream of Lower Granite Reservoir (RM 149) and Hells Canyon Dam (RM 247), and the lower reaches of the Grande Ronde, Clearwater, and Tucannon Rivers, tributaries to the Snake River. Redds in the Clearwater River have been observed from its mouth to slightly upstream of its confluence with the north fork (about 40 miles).

No reliable estimates of historical abundance are available (Waples *et al.* 1991b), but because of their dependence on mainstem habitat for spawning, fall Chinook have probably been affected to a greater extent by irrigation and hydroelectric projects than any other species of salmon in the Snake River Basin. The mean number of adult SR fall Chinook salmon declined from 72,000 in the 1930s and 1940s to 29,000 during the 1950s. In spite of this, the Snake River remained the most important natural production area for fall Chinook in the Columbia River Basin through the 1950s. The number of adults counted at the uppermost Snake River mainstem dams averaged 12,720 total spawners from 1964 to 1968; 3,416 spawners from 1969 to 1974; and 610 spawners from 1975 to 1980 (Waples, *et al.* 1991b). Most adult SR fall Chinook spend three years at sea before migrating up the Columbia and Snake Rivers between August and October (Waples *et al.* 1991b). Spawning occurs in the mainstem Snake River and in the lower parts of its major tributaries in between late October and mid-December, typically peaking in November (Myers *et al.* 1998). Fry emerge from the spawning beds from late March through early June. At present, the peak of the smolt outmigration usually occurs in July, however juvenile fall Chinook may be found migrating in the lower Snake and Columbia rivers from May through October.[3] SR fall Chinook typically exhibit an "ocean" type juvenile life history pattern, usually rearing in freshwater for only a few months before migrating to the ocean.

[3] In its comments on the draft USBR 1999 Biological Opinion, the State of Idaho commented that "it is generally accepted that peak juvenile Snake River fall Chinook migration historically coincided with the declining hydrograph following spring snowmelt" (Kempthorne 1999). However, Krzma and Raleigh (1970) observed that the migration of juvenile fall Chinook into Brownlee Reservoir in 1962 and 1963 began in mid-April, and ended by mid-June (roughly 75% of the migration took place during the second and third weeks of May in those years). Juvenile fall Chinook captured between mid-May and mid-June averaged 71, 81, and 79 millimeters in 1962, 1963, and 1964, respectively. Similarly, Mains and Smith (1964), who monitored the migration of Chinook salmon in the lower Snake River (RM 82) in 1954 and 1955, collected Chinook salmon fry (most likely those of fall Chinook salmon) migrating in March and April, and documented that the migration of Chinook salmon smolts was nearly complete by the end of June. The average length of fingerlings in June was 90.7 mm. Thus, the historic migration of fall Chinook salmon through the Snake River was more likely to have occurred between late-May and late-June, nearer the peak of historical hydrograph.

Table 1. Endangered and threatened pacific salmon and steelhead under NOAA Fisheries' jurisdiction in the Columbia River Basin. Federal Register Notices for Final Rules that list species, designate critical habitat, or apply protective regulations to ESUs considered in this consultation. (Listing status 'T' means listed as threatened, 'E' means listed as endangered, and 'P' means proposed for listing).

Species ESU	Listing Status	Critical Habitat	Protective Regulations
Chinook salmon (*Oncorhynchus tshawytscha*)			
Lower Columbia River	T 3/24/99; 64 FR 14308	Not applicable	7/10/00; 65 FR 42422
Upper Willamette River	T 3/24/99; 64 FR 14308	Not applicable	7/10/00; 65 FR 42422
Upper Columbia River spring-run	E 3/27/99; 64 FR 14308	Not applicable	ESA section 9 applies
Snake River spring / summer run	T 4/22/92; 57 FR 14653	10/25/99; 64 FR 57399	7/10/00; 65 FR 42422
Snake River fall-run	T 6/3/92; 57 FR 23458	12/28/93; 58 FR 68543	7/10/00; 65 FR 42422
Chum salmon (*O. keta*)			
Columbia River	T 3/25/99; 64 FR 14508	Not applicable	7/10/00; 65 FR 42422
Coho salmon (*O. kisutch*)			
Lower Columbia River	P 6/14/04; 69 FR 33102	Not applicable	Not applicable
Sockeye salmon (*O. nerka*)			
Snake River	E 11/20/91; 56 FR 58619	12/28/93; 58 FR 68543	ESA section 9 applies
Steelhead (*O. mykiss*)			
Lower Columbia River	T 3/19/98; 63 FR 13347	Not applicable	7/10/00; 65 FR 42422
Upper Willamette River	T 3/25/99; 64 FR 14517	Not applicable	7/10/00; 65 FR 42422
Middle Columbia River	T 3/25/99; 64 FR 14517	Not applicable	7/10/00; 65 FR 42422
Upper Columbia River	E 8/18/97; 62 FR 43937	Not applicable	ESA section 9 applies
Snake River Basin	T 8/18/97; 62 FR 43937	Not applicable	7/10/00; 65 FR 42422

SR Spring/Summer Chinook Salmon

It is estimated that at least 1.5 million spring/summer Chinook salmon returned to the Snake River in the late 1800s, approximately 39 to 44% of all spring/summer Chinook in the Columbia River Basin. Historically, Shoshone Falls (RM 615) was the uppermost limit to spring/summer Chinook migration, and spawning occurred in virtually all suitable and accessible habitat in the Snake River Basin (Fulton 1968 and Matthews and Waples 1991). The development of mainstem irrigation and hydroelectric projects in the mainstem Snake River Basin have significantly reduced the amount of habitat available for spring/summer Chinook such that between 1950 and 1960, an average of 125,000 adults returned to the Snake River, only 8% of the historic estimate. An estimated average of 100,000 wild adults would have returned from 1964 to 1968 each year after adjusting for fish harvested in the river fisheries below McNary Dam. However, actual counts of wild adults at Ice Harbor Dam annually averaged only 59,000 each year from 1962 to 1970. The estimated number of wild adult Chinook salmon passing Lower Granite Dam between 1980 and 1990 was 9,674 fish (Matthews and Waples 1991). A recent 5-year geometric mean (1992 to 1996) was only 3,820 naturally-produced spawners (Myers *et al.* 1998). This is less than 0.3% of the estimated historical abundance of wild SR spring/summer Chinook.

SR spring/summer Chinook migrate through the Columbia River from March through July, and spawn in smaller, higher elevation streams than do fall Chinook. Fry generally emerge from the gravel between February and June. SR spring/summer Chinook exhibit a “stream” type juvenile life history pattern, rearing for one, or sometimes even two years in freshwater before migrating to the ocean from April through June. These smolts are often referred to “yearling” Chinook. Adults typically remain in the ocean for two or three years before returning to spawn (Matthews and Waples 1991).

SR Sockeye Salmon

Before the turn of the century (c. 1880), about 150,000 sockeye salmon ascended the Wallowa, Payette, and Salmon River Basins to spawn in natural lakes (Evermann 1895). Sockeye populations in the Payette Basin lakes were eliminated after a diversion dam near Horseshoe Bend was constructed in 1914, and Black Canyon Dam was completed in 1924. In 1916, a dam at Wallowa Lake was increased in height, resulting in the extinction of indigenous sockeye in Wallowa Lake. Sockeye salmon in the Salmon River occurred historically in at least four lakes within Idaho’s Stanley Basin: Alturas, Redfish, Pettit, and Stanley Lakes. Sunbeam Dam, 20 miles downstream from Redfish Lake, severely limited sockeye and other anadromous salmonid production in the upper Salmon River between 1910 to 1934 (Waples *et al.* 1991a). In the 1950s and 1960s, more than 4,000 adults returned annually to Redfish Lake. Between 1985 and 1987, an average of 13 sockeye were counted at the Redfish Lake weir. Only 10 sockeye have returned to Redfish Lake since 1994: One in 1994, one in 1996, one in 1998 and seven in 1999 (all of those returning in 1999 were 2nd generation progeny of wild sockeye that returned to Idaho in 1993). Since 1991, adult sockeye returning to Redfish Lake have been captured to support a captive broodstock program.

Historically, SR sockeye salmon adults entered the Columbia River in June and July, migrated upstream through the Snake and Salmon Rivers, and arrived at Redfish Lake in August and September. Spawning peaks in October and occurs in lakeshore gravels. Fry emerge in late April and May and move immediately to the open waters of the lake where they feed on plankton for one to three years before migrating to the ocean. Juvenile sockeye generally leave Redfish Lake from late April through May, and migrate nearly 900 miles to the Pacific Ocean. Although pre-dam reports indicate that sockeye salmon smolts migrated in May and June, tagged sockeye smolts from Redfish Lake passed Lower Granite Dam from mid-May to mid-July. SR sockeye spend 2 to 3 years in the Pacific Ocean before returning to their natal lake to spawn.

<u>SR Steelhead</u>

Historically, SR steelhead spawned in virtually all accessible habitat in the Snake River up to Shoshone Falls (RM 615). The development of irrigation and hydropower projects on the mainstem Snake River have significantly reduced the amount of available habitat for this species. No valid historical estimates of adult steelhead returning to the Snake River Basin before the completion of Ice Harbor Dam in 1962 are available. However, SR steelhead sportfishing catches ranged from 20,000 to 55,000 fish during the 1960s (Fulton 1970). The run of steelhead was likely several times as large as the sportfish take. Between 1949 and 1971, adult steelhead counts at Lewiston Dam (on the Clearwater River) averaged about 40,000 per year. The count at Ice Harbor Dam in 1962 was 108,000 and averaged approximately 70,000 per year between 1963 and 1970.

A recent 5-year geometric mean (1990 to 1994) for escapement above Lower Granite Dam was approximately 71,000. However, the wild component of this run was only 9,400 adults (7,000 A-run and 2,400 B-run). In recent years average densities of wild juvenile steelhead have decreased significantly for both A-run and B-run steelhead. Many basins within the Snake River are significantly under-seeded relative to the carrying capacity of streams (Busby *et al.* 1996).

Steelhead populations exhibit both anadromous (steelhead) and freshwater resident (rainbow or red-band trout) forms. Unlike other Pacific salmon species, steelhead are capable of spawning on more than one occasion, returning to the ocean to feed between spawning events. SR steelhead rarely return to spawn a second time. Steelhead can be classified into two reproductive types: Stream-maturing steelhead, which enter fresh water in a sexually immature condition and wait several months before spawning; and ocean-maturing steelhead, which return to freshwater with fully-developed gonads and spawn shortly thereafter. In the Pacific Northwest, stream-maturing steelhead enter fresh water between May and October and are referred to as "summer" steelhead. In comparison, ocean-maturing steelhead return between November and April and are considered "winter" steelhead. Inland steelhead populations in the Columbia River Basin are almost exclusively of the summer variety (Busby *et al.* 1996).

SR steelhead can be further divided into two groupings: A-run steelhead and B-run steelhead. This dichotomy reflects the bimodal migration of adult steelhead observed at Bonneville Dam. A-run steelhead generally return to fresh water between June and August after spending 1 year in the ocean. These fish are typically less than 77.5 centimeters (cm) in length. B-run steelhead usually return to fresh water from late August to October after spending 2 years in the ocean and are generally greater than 77.5 cm in length.

Both A-run and B-run spawn the following spring from March to May in small to mid-sized streams. The fry emerge in 7 to 10 weeks, depending on temperature, and usually spend 2 or 3 years in fresh water before migrating to the ocean from April to mid-June. These estimates are based on population averages and steelhead are capable of remarkable plasticity with in their life cycles.

<u>LCR Chinook Salmon</u>

The LCR Chinook salmon ESU includes all native populations from the mouth of the Columbia River to the crest of the Cascade Range, excluding populations above Willamette Falls. The former location of Celilo Falls (inundated by The Dalles reservoir in 1960) is the eastern boundary for this ESU. Stream-type, spring-run Chinook salmon found in the Klickitat River, or the introduced Carson spring-run Chinook salmon strain, are not included in this ESU. Spring-run Chinook salmon in the Sandy River have been influenced by spring-run Chinook salmon introduced from the Willamette River ESU. However, analyses suggest that considerable genetic resources still reside in the existing population (Myers *et al.* 1998). Recent escapements above Marmot Dam on the Sandy River average 2,800 and have been increasing (ODFW 1998).

Historical records of Chinook salmon abundance are sparse, but cannery records suggest a peak run of 4.6 million fish in 1883. Although fall-run Chinook salmon are still present throughout much of their historical range, most of the fish spawning today are first-generation hatchery strays. Furthermore, spring-run populations have been severely depleted throughout the ESU and extirpated from several rivers.

Apart from the relatively large and apparently healthy fall-run population in the Lewis River, production in this ESU appears to be predominantly hatchery-driven with few identifiable naturally-spawned populations. All basins are affected (to varying degrees) by habitat degradation. Hatchery programs have had a negative effect on the native ESU. Efforts to enhance Chinook salmon fisheries abundance in the lower Columbia River began in the 1870s. Available evidence indicates a pervasive influence of hatchery fish on natural populations throughout this ESU, including both spring- and fall-run populations. The large number of hatchery fish in this ESU make it difficult to determine the proportion of naturally-produced fish. The loss of fitness and diversity within the ESU is an important concern. The median population growth rate over a base period from 1980 through 1998 ranged from 0.98 to 0.88, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared with that of fish of wild origin (McClure *et al.* 2000).

<u>UCR Spring Chinook Salmon</u>

The UCR ESU includes spring-run Chinook populations found in Columbia River tributaries between Rock Island and Chief Joseph Dams, notably the Wenatchee, Entiat, and Methow River Basins. The populations are genetically and ecologically separate from the summer- and fall-run populations in the lower parts of many of the same river systems (Myers *et al.* 1998). Although fish in this ESU are genetically similar to spring Chinook in adjacent ESUs, they are distinguished by ecological differences in spawning and rearing habitat preferences. For example, spring-run Chinook in upper Columbia River tributaries spawn at lower elevations (500 to 1,000 m) than in the Snake and John Day River systems.

The UCR populations were intermixed during the Grand Coulee Fish Maintenance Project (1939 through 1943), resulting in loss of genetic diversity between populations in the ESU. Homogenization remains an important feature of the ESU. Fish abundance has tended downward both recently and over the long term. At least six former populations from this ESU are now extinct, and nearly all extant populations have fewer than 100 wild spawners.

Given the lack of information on Chinook salmon stocks that are presumed to be extinct, the relationship of these stocks to existing ESUs is uncertain. Recent total abundance within this ESU is quite low, and escapements in 1994 to 1996 were the lowest in at least 60 years. At least six populations of spring Chinook salmon in this ESU have become extinct, and almost all remaining naturally-spawning populations have fewer than 100 spawners. Extinction risks for UCR spring Chinook salmon are 50% for the Methow, 98% for the Wenatchee, and 99% for the Entiat spawning populations (Cooney 2002). In 2002, the spring Chinook count at Priest Rapids Dam was 34,083, with 24,000 arriving at Rock Island Dam. The 2002 count was about 67.6% and 242% of the respective 2001 and 10-year average adult spring Chinook count at Priest Rapids Dam.

UWR Chinook Salmon

The UWR Chinook salmon ESU includes native spring-run populations above Willamette Falls and in the Clackamas River. In the past, it included sizable numbers of spawning salmon in the Santiam River, the middle fork of the Willamette River, and the McKenzie River, as well as smaller numbers in the Molalla River, Calapooia River, and Albiqua Creek. Although the total number of fish returning to the Willamette has been relatively high (24,000), about 4,000 fish now spawn naturally in the ESU, two-thirds of which originate in hatcheries. The McKenzie River supports the only remaining naturally-reproducing population in the ESU (ODFW 1998).

There are no direct estimates of the size of the Chinook salmon runs in the Willamette River Basin before the 1940s. The Native American fishery at the Willamette Falls may have yielded 908,000 kilograms of salmon (454,000 fish, each weighing 9.08 kg) (McKernan and Mattson 1950). Egg collections at salmon hatcheries indicate that the spring Chinook salmon run in the 1920s may have been five times the run size of 55,000 fish in 1947, or 275,000 fish (Mattson 1948). Much of the early information on salmon runs in the upper Willamette River Basin comes from operation reports of state and Federal hatcheries.

Fish in this ESU are distinct from those of adjacent ESUs in life history and marine distribution. The life history of Chinook salmon in the UWR ESU includes traits from both ocean- and stream-type development strategies. Tag recoveries indicate that the fish travel to the marine waters off British Columbia and Alaska. More Willamette fish are recovered in Alaskan waters than fish from the LCR ESU. UWR Chinook salmon mature in their fourth or fifth years.

Historically, 5-year-old fish dominated the spawning migration runs, however, recently most fish have matured at age 4. The timing of the spawning migration is limited by Willamette Falls. High flows in the spring allow access to the upper Willamette River Basin, whereas low flows in the summer and autumn prevent later-migrating fish from ascending the falls. The low flows may serve as an isolating mechanism, separating this ESU from others nearby.

While the abundance of UWR spring Chinook salmon has been relatively stable over the long term and there is evidence of some natural production, at present natural production and harvest levels the natural population is not replacing itself. With natural production accounting for only one-third of the natural spawning escapement, natural spawners may not be capable of replacing themselves even in the absence of fisheries. The introduction of fall-run Chinook into the basin and the laddering of Willamette Falls have increased the potential for genetic introgression between wild spring- and hatchery fall-run Chinook. Habitat blockage and degradation are significant problems in this ESU.

The median population growth rate over a base period from 1980 through 1998 ranges from 1.01 to 0.63, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared with that of fish of wild origin (McClure *et al.* 2000).

<u>CR Chum Salmon</u>
Chum salmon of the CR ESU spawn in tributaries and in mainstem areas below Bonneville Dam. Most fish spawn on the Washington side of the Columbia River (Johnson *et al.* 1997). Previously, chum salmon were reported in almost every river in the lower Columbia River Basin, but most runs disappeared by the 1950s (Rich 1942, Marr 1943, Fulton 1970). The Washington Department of Fish and Wildlife (WDFW) regularly monitors only a few natural populations in the basin, one in Grays River, two in small streams near Bonneville Dam, and the mainstem area next to one of the latter two streams. Recently, spawning has occurred in the mainstem Columbia River at two spots near Vancouver, Washington, and in Duncan Creek below the Bonneville Dam.

Historically, the CR chum salmon ESU supported a large commercial fishery in the first half of this century, landing more than 500,000 fish per year as recently as 1942. Commercial catches declined beginning in the mid-1950s, and in later years rarely exceeded 2,000 per year. There are now no recreational or directed commercial fisheries for chum salmon in the Columbia River, although chum salmon are taken incidentally in the gill-net fisheries for coho and Chinook salmon, and some tributaries have a minor recreational harvest (WDF *et al.* 1993). Observations of chum salmon still occur in most of the 13 basins/areas that were identified in 1951 as hosting chum salmon, however, fewer than 10 fish are usually observed in these areas. In 1999, the WDFW located another Columbia River mainstem spawning area for chum salmon near the I-205 bridge (WDFW 2000).

Chum salmon enter the Columbia River from mid-October through early December and spawn from early November to late December. Recent genetic analysis of fish from Hardy and Hamilton Creeks and from the Grays River indicate that these fish are genetically distinct from other chum salmon populations in Washington. Genetic variability within and between populations in several geographic areas is similar, and populations in Washington show levels of genetic subdivision typical of those seen between summer- and fall-run populations in other areas, and are typical of populations within run types (Salo 1991, WDF *et al.* 1993, Phelps *et al.* 1994, Johnson *et al.* 1997).

The median population growth rate is 1.04 over a base period from 1980 through 1998 for the ESU as a whole (McClure *et al.* 2000). Because census data are peak counts (and because the precision of those counts decreases markedly during the spawning season as water levels and turbidity rise), NOAA Fisheries is unable to estimate the risk of absolute extinction for this ESU.

<u>MCR Steelhead</u>
The MCR ESU occupies the Columbia River Basin from above the Wind River in Washington and the Hood River in Oregon, and continues upstream to include the Yakima River in Washington. The region includes some of the driest areas of the Pacific Northwest, generally receiving less than 40 centimeters of precipitation annually (Jackson 1993). Summer steelhead are widespread throughout the ESU; winter steelhead occur in Mosier, Chenowith, Mill, and Fifteenmile Creeks in Oregon, and in the Klickitat and White Salmon Rivers in Washington. The John Day River probably represents the largest native, natural spawning stock of steelhead in the region.

Estimates of historical (pre-1960s) abundance specific to this ESU are available for the Yakima River, which has an estimated run size of 100,000 (WDF *et al.* 1993). Assuming comparable run sizes for other drainage areas in this ESU, the total historical run size may have exceeded 300,000 steelhead (NOAA 2000a).

Most fish in this ESU smolt at two years and spend 1 to 2 years in salt water before re-entering freshwater, where they may remain up to a year before spawning (Howell *et al.* 1985). All steelhead upstream of The Dalles Dam are summer-run (Schreck *et al.* 1986, Reisenbichler *et al.* 1992, Chapman *et al.* 1994, Busby *et al.* 1996). The Klickitat River, however, produces both summer and winter steelhead, and age-2-ocean steelhead dominate the summer steelhead, whereas most other rivers in the region produce about equal numbers of both age 1- and 2-ocean fish. A non-anadromous form co-occurs with the anadromous form in this ESU, and information suggests that the two forms may not be isolated reproductively, except where barriers are involved.

Current population sizes are substantially lower than historic levels, especially in the rivers with the largest steelhead runs in the ESU, the John Day, Deschutes, and Yakima Rivers. At least two extinctions of native steelhead runs in the ESU have occurred (the Crooked and Metolius Rivers, both in the Deschutes River Basin). For the MCR steelhead ESU as a whole, (NOAA 2000a) estimates that the median population growth rate over the base period (1990-1998) ranges from 0.88 to 0.75, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared with that of fish of wild origin (McClure *et al.* 2000). In 2002, the count of Bonneville Dam steelhead totaled 481,036 and exceeded all counts recorded at Bonneville Dam since 1938, except the 2001 total, which was 633,464. Of the total return in 2002, 143,032 were considered wild steelhead (Fish Passage Center 2003).

LCR Steelhead

The LCR ESU encompasses all steelhead runs in tributaries between the Cowlitz and Wind Rivers on the Washington side of the Columbia, and the Willamette and Hood Rivers on the Oregon side. The populations of steelhead that make up the LCR steelhead ESU are distinguished from adjacent populations by genetic and habitat characteristics. The ESU consists of summer and winter coastal steelhead runs in the tributaries of the Columbia River as it cuts through the Cascades. These populations are genetically distinct from inland populations (east of the Cascades), as well as from steelhead populations in the upper Willamette River Basin and coastal runs north and south of the Columbia River mouth. Not included in the ESU are runs in the Willamette River above Willamette Falls (UWR ESU), runs in the Little and Big White Salmon Rivers (MCR ESU), and runs based on four imported hatchery stocks: Early-spawning winter Chambers Creek/Lower Columbia River mix, summer Skamania Hatchery stock, winter Eagle Creek National Fish Hatchery stock, and winter Clackamas River Oregon Department of Fish and Wildlife (ODFW) stock (63 FR 13351 and 13352). This area has at least 36 distinct runs (Busby *et al.* 1996), 20 of which were identified in the initial listing petition. In addition, numerous small tributaries have historical reports of fish, but no current abundance data. The major runs in the ESU, for which there are estimates of run size, are the Cowlitz River winter runs, Toutle River winter runs, Kalama River winter and summer runs, Lewis River winter and summer runs, Washougal River winter and summer runs, Wind River summer runs, Clackamas River winter and summer runs, Sandy River winter and summer runs, and Hood River winter and summer runs (NOAA 2000a).

All runs in the LCR steelhead ESU have declined from 1980 to 2000, with sharp declines beginning in 1995 (NOAA Fisheries 2000a). Historic counts in some of the larger tributaries (Cowlitz, Kalama, and Sandy Rivers) probably exceeded 20,000 fish; more recent counts have been in the range of 1,000 to 2,000 fish (NOAA 2000a). Habitat loss, hatchery steelhead introgression, and harvest are the major contributors to the decline of steelhead in this ESU. For the LCR steelhead ESU, NOAA (2000a) estimates that the median population growth rate over the base period (1990-1998) ranges from 0.98 to 0.78, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared with that of fish of wild origin (McClure *et al.* 2000).

UWR Steelhead

The UWR steelhead ESU occupies the Willamette River and tributaries upstream of Willamette Falls, extending to and including the Calapooia River. These major river basins containing spawning and rearing habitat comprise more than 12,000 square kilometers in Oregon. Rivers that contain naturally-spawning winter-run steelhead include the Tualatin, Molalla, Santiam, Calapooia, Yamhill, Rickreall, Luckiamute, and Mary's, although the origin and distribution of steelhead in a number of these basins is being debated. Early migrating winter and summer steelhead have been introduced into the upper Willamette River Basin, but those components are not part of the ESU. Native winter steelhead within this ESU have been declining since 1971, and have exhibited large fluctuations in abundance.

Over the past several decades, total abundance of natural late-migrating winter steelhead ascending the Willamette Falls fish ladder has fluctuated several times over a range of approximately 5,000 to 20,000 spawners. However, the last peak occurred in 1988, and this peak has been followed by a steep and continuing decline. Abundance in each of year from 1993 to 1998, was below 4,300 fish, and the run in 1995 was the lowest in 30 years.

In general, native steelhead of the UWR are late-migrating winter steelhead, entering freshwater primarily in March and April. This atypical run timing appears to be an adaptation for ascending Willamette Falls, which functions as an isolating mechanism for UWR steelhead. Reproductive isolation resulting from the falls may explain the genetic distinction between steelhead from the upper Willamette River Basin and those in the lower river. UWR late-migrating steelhead are ocean-maturing fish. Most return at age 4, with a small proportion returning as 5-year-olds (Busby *et al.* 1996). Willamette Falls (River kilometer 77) is a known migration barrier (NOAA 2000a). Winter steelhead and spring Chinook salmon historically occurred above the falls, whereas summer steelhead, fall Chinook, and coho salmon did not. Detroit and Big Cliff Dams cut off access to 540 kilometer (km) of spawning and rearing habitat in the North Santiam River. In general, habitat in this ESU has become substantially simplified since the 1800s by removal of large woody debris to increase the river's navigability.

Habitat loss, hatchery steelhead introgression, and harvest are the major contributors to the decline of steelhead in this ESU. For the UWR steelhead ESU, the estimated median population growth rate for 1990 to 1998 ranged from 0.94 to 0.87, decreasing as the effectiveness of hatchery fish spawning in the wild increased compared with that of fish of wild origin (McClure *et al.* 2000).

UCR Steelhead

This inland steelhead ESU occupies the Columbia River Basin upstream from the Yakima River to the U.S./Canada border. Rivers in the area primarily drain the east slope of the northern Cascade Mountains and include the Wenatchee, Entiat, Methow, and Okanogan River Basins.

Estimates of historical (pre-1960s) abundance specific to this ESU are available from fish counts at dams (NOAA 2000a). Counts at Rock Island Dam from 1933 to 1959 averaged 2,600 to 3,700, suggesting a pre-fishery run size exceeding 5,000 adults for tributaries above Rock Island Dam (Chapman *et al.* 1994, Busby *et al.* 1996). Lower Columbia River harvests had already depressed fish stocks during the period in which these counts were taken, thus, the pre-fishery estimate should be viewed with caution.

Habitat degradation, juvenile and adult mortality in the hydropower system, and unfavorable environmental conditions in both marine and freshwater habitats have contributed to the declines and represent risk factors for the future. Harvest in lower river fisheries and genetic homogenization from composite broodstock collection are other factors that may contribute significant risk to the UCR steelhead ESU.

The median population growth rate over a base period from 1990 through 1998 ranged from 0.94 to 0.66, decreasing as the effectiveness of hatchery fish spawning in the wild increased compared with that of fish of wild origin (McClure *et al.* 2000). In 2002, 15,286 steelhead were counted at Rock Island Dam, compared with the 2001 count of 28,602, and the 10-year average return of 9,165. Of the total steelhead counted at Rock Island Dam in 2002, 10,353 were wild steelhead (Fish Passage Center 2003).

LCR Coho Salmon

The status of LCR coho salmon was initially reviewed by NOAA Fisheries in 1996 (NMFS 1996b) and the most recent review occur in 2001 (NMFS 2001a). In the 2001 review, the BRT was very concerned that the vast majority (over 90%) of the historical populations in the LCR coho salmon ESU appear to be either extirpated or nearly so. The two populations with any significant production (Sandy and Clackamas) were at appreciable risk because of low abundance, declining trends and failure to respond after a dramatic reduction in harvest. The large number of hatchery coho salmon in the ESU was also considered an important risk factor. The majority of the 2001 BRT votes were for ‘at risk of extinction’ with a substantial minority in ‘likely to become endangered.’

New analyses include the tentative designation of demographically independent populations, the recalculation of metrics reviewed by previous BRTs with additional years of data, estimates of median annual growth rate under different assumptions about the reproductive success of hatchery fish, a new stock assessment of Clackamas River coho by the ODFW (Zhou and Chilcote 2003), and estimates of current and historically available kilometers of stream.

As part of its effort to develop viability criteria for LCR salmon and steelhead, the Willamette/Lower Columbia Technical Recovery Team has identified historically demographically independent populations of ESA-listed salmon and steelhead in the Lower Columbia River (Myers *et al.* 2002). Population boundaries are based on an application of Viable Salmonid Populations definition (McElhany *et al.* 2000). Based on the Willamette Lower Columbia Technical Review Team’s framework for Chinook and steelhead, the BRT tentatively designated populations of LCR coho salmon. A working group at the Northwest Fisheries Science Center hypothesized that the LCR coho salmon ESU historically consisted of 23 populations.

Previous BRT and ODFW analyses have treated the coho in the Clackamas River as a single population (see previous status review updates for more complete discussion and references). However, recent analysis by ODFW (Zhou and Chilcote 2003) supports the hypothesis that coho salmon in the Clackamas River consist of two populations, an early run and a late run. The late run population is believed to be descendant of the native Clackamas River population, and the early run is believed to descend from hatchery fish introduced from Columbia River populations outside the Clackamas River Basin. The population structure of Clackamas River coho is uncertain, therefore, in the BRT (2003) report, analyses on Clackamas River coho are conducted under both the single population and two population hypotheses for comparison.

The paucity of naturally-produced spawners in this ESU can be contrasted with the very large number of hatchery-produced adults. Although the scale of the hatchery programs, and the great disparity in relative numbers of hatchery and wild fish, produce many genetic and ecological threats to the natural populations, collectively these hatchery populations contain a great deal of genetic resources that might be tapped to help promote restoration of more widespread naturally-spawning populations.

The status of this LCR coho salmon was reviewed by the BRT in 2000, so relatively little new information was available. A majority (68%) of the likelihood votes for LCR coho salmon fell in the 'danger of extinction' category, with the remainder falling in the 'likely to become endangered' category. As indicated by the risk matrix totals, the BRT had major concerns for this ESU in all VSP risk categories (risk estimates ranged from high risk for spatial structure/connectivity and growth rate/productivity to very high for diversity). The most serious overall concern was the scarcity of naturally-produced spawners throughout the ESU, with attendant risks associated with small population, loss of diversity, and fragmentation and isolation of the remaining naturally-produced fish. In the only two populations with significant natural production (Sandy and Clackamas), short- and long-term trends are negative, and productivity (as gauged by preharvest recruits) is down sharply from recent (1980s) levels.

Generalized Fish Use in the Lower Columbia River

Based on the life histories of listed salmon and steelhead, fish likely will be present in the action area throughout the proposed construction period. The action area serves primarily as rearing habitat, especially for juvenile Chinook and coho salmon in the Columbia River plume, and saltwater acclimation habitat for juvenile salmon and steelhead, and migration habitat for adult salmon and steelhead. In the lower Columbia River, juvenile and adult steelhead migrate year-round, with peak smolt out-migration occurring May through June, and peak adult emigration occurring January through June. Juvenile and adult sockeye salmon migrate April through August, with peak smolt out-migration occurring May through June, and peak adult emigration occurring June through July. Juvenile and adult Chinook salmon migrate year-round, with peak smolt out-migration occurring March through July, and peak adult emigration occurring March through October. Juvenile and adult chum salmon migrate October through May, with peak smolt out-migration occurring March through May, and peak adult emigration occurring October through November. Juvenile and adult coho salmon migrate April through November, with peak smolt out-migration occurring March through May, and peak adult emigration occurring September through October.

Critical Habitat

NOAA Fisheries designates critical habitat based on physical and biological features that are essential to the listed species. For this Opinion, NOAA Fisheries has designated critical habitat for SR sockeye salmon, SR spring/summer Chinook salmon, and SR steelhead (Table 1). The essential features of designated critical habitat within the action area that support successful migration, holding, rearing, and smoltification for ESA-listed salmonid fishes include: (1) Substrate, (2) water quality, (3) water quantity, (4) water temperature, (5) water velocity, (6) cover/shelter, (7) food (primarily juvenile), (8) riparian vegetation, (9) space, and (10) safe passage conditions.

Environmental Baseline

The environmental baseline includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 C.F.R. 402.02). For projects that are ongoing actions, the effects of future actions over which the Federal agency has discretionary involvement or control will be analyzed as effects of the action.

NOAA Fisheries describes the environmental baseline in terms of the biological requirements for habitat features and processes necessary to support life stages of the subject ESUs within the action area. When the environmental baseline departs from those biological requirements, the adverse effects of a proposed action on the ESU or its habitat are more likely to jeopardize the listed species or result in destruction or adverse modification of critical habitat (NMFS 1999).

The biological requirements of salmon and steelhead in the action area vary depending on the life history stage present and the natural range of variation present within that system (Groot and Margolis 1991, NRC 1996, Spence *et al.* 1996). Generally, during spawning migrations, adult salmon require clean water with cool temperatures and access to thermal refugia, dissolved oxygen near 100% saturation, low turbidity, adequate flows and depths to allow passage over barriers to reach spawning sites, and sufficient holding and resting sites. Habitat requirements for juvenile rearing include seasonally suitable microhabitats (*e.g.*, thermal refugia) for holding, feeding, and resting. Physical, chemical, and thermal conditions may all impede migrations of adult or juvenile fish. Each ESU considered in this Opinion resides in or migrates through the action area. Thus, for this action area, the biological requirements for salmon and steelhead are the habitat characteristics that would support successful rearing and migration of the species listed in Table 1.

To a significant degree, the risk of extinction for salmon and steelhead stocks in the Columbia River Basin has increased because complex freshwater and estuarine habitats needed to maintain diverse wild populations and life histories have been lost and fragmented. Not only have salmonid rearing habitats been eliminated, but the connections among habitats needed to support tidal and seasonal movements of juvenile salmon have been severed.

Approximately 43% of tidal marsh habitat in the Columbia River estuary has been lost (from 16,180 acres historically to 9,200 acres today), and 77% of its historic tidal swamp habitats (from 32,020 acres historically to 6,950 acres today) between 1870 and 1970 (Thomas 1983).

One example is the diking and filling of floodplains that were formerly connected to the tidal river. This practice eliminated large expanses of low-energy, off-channel habitat for salmon rearing and migrating during high flows. Similarly, diking of estuarine marshes and forested wetlands within the estuary removed most of these important off-channel habitats. Historically, the action area included coniferous forests, high salt marsh wetlands, and low marsh/swamp/forested wetlands (CREDDP 1984).

The Columbia River, from Tenasillahe Island to the Willamette River, is on the 1998 Oregon Department of Environmental Quality (DEQ) 303(d) list as water quality limited for the following parameters: Temperature, bacteria, dissolved oxygen, total dissolved gas, pH, and toxics, DDE, DDT, arsenic, and PCBs.

NOAA Fisheries concludes that not all of the biological requirements of the listed species within the action area are being met under current conditions. Based on the best available information on the subject species status, including population status, trends, and genetics, and the environmental baseline conditions within the action area, significant improvement in habitat conditions is needed to meet the biological requirements for the survival and recovery of the species.

Effects of the Action

The effects of the action means the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 C.F.R. 402.02). If the proposed action includes offsite measures to reduce net adverse impacts by improving habitat conditions and survival, NOAA Fisheries will evaluate the net combined effects of the proposed action and the offsite measures.

Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur (50 C.F.R. 402.02). Indirect effects may occur outside the area directly affected by the action, and may include other Federal actions that have not undergone section 7 consultation but will result from the action under consideration. To be considered indirect effect, such actions must be: (1) Reasonably certain to occur, as evidenced by appropriations, work plans, permits issued, or budgeting; (2) follow a pattern of activity undertaken by the agency in the action area; or (3) be a logical extension of the proposed action.

Interrelated actions are those that are part of a larger action and depend on the larger action for their justification; interdependent actions are those that have no independent utility apart from the action under consideration (50 C.F.R. 402.02). Future Federal actions that are not a direct effect of the action under consideration, and not included in the environmental baseline or treated as indirect effects, are not considered in this Opinion.

Effects on Listed Species

I. Construction Effects

Construction activities that occur in or beside stream channels, such as excavation, intake installation, pile installation (*i.e.*, steel sheet piles, H-piles, and hollow steel piles), coffer dam installation and removal, removal and placement of riprap, vegetation removal, and grading are likely to result in fish being killed or injured, or more likely, temporarily displaced by in-water work activities. In-water construction activities are likely to temporarily affect water quality due to increases in turbidity within ±250 feet from in-water and near-shore activities. Effects of in-water and near-shore construction would be similar to those described below under *Water Quality - Turbidity*. The proposed in-water work window and the proposed conservation measures are likely to reduce the intensity of some of the adverse effects from construction activities in or beside the river and on listed fish; although there is uncertainty due to limited details provided on the conservation measures.

II. Ground Disturbance

Excavation would temporarily remove approximately 1,403 cubic yards of soil and rock from the bank and bed of the Columbia River. Excavation would also remove up to 0.15 acres of vegetation, temporarily increasing sediment yield potential into the Columbia River. The proposed conservation measures are likely to reduce the intensity of some of the adverse effects from construction activities in or beside the river and on listed fish; although there is uncertainty due to limited details provided on the conservation measures. Effects of increased sediment yields are likely to lead to effects similar to those described below under *Water Quality - Turbidity*.

III. Water Quality - Turbidity

Construction activities that occur in stream channels, such as excavation, sheet pile installation and removal, pile installation, and placement of riprap, are likely to temporarily increase in turbidity. Potential effects from project-related increases in turbidity on salmonid fishes include, but are not limited to: (1) Reduction in feeding rates and growth, (2) increased mortality, (3) physiological stress, (4) behavioral avoidance, (5) reduction in macroinvertebrate populations, and (6) temporary beneficial effects. Potential beneficial effects include a reduction in piscivorous fish/bird predation rates, enhanced cover conditions, and improved survival conditions.

Increases in turbidity can adversely affect filter-feeding macroinvertebrates and fish feeding. At concentrations of 53 to 92 parts per million (ppm) (24 hours) macroinvertebrate populations were reduced (Gammon 1970). Concentrations of 250 ppm (1 hour) caused a 95% reduction in feeding rates in juvenile coho salmon (Noggle 1978). Concentrations of 1200 ppm (96 hours) killed juvenile coho salmon (Noggle 1978). Concentrations of 53.5 ppm (12 hours) caused physiological stress and changes in behavior in coho salmon (Berg 1983). Similar responses can be expected for the subject salmonid species.

Increases in turbidity are likely to increase physiological stress, result in physical injury (*e.g.*, gill abrasion), and potentially displace rearing juvenile salmon and steelhead (Bisson and Bilby 1992). In-water work would occur during the ODFW-recommended in-water work window of November 1 to February 28. This is a time of year when river discharge stage can be as high as 1.5 million cfs, tidal surge may reach +10 feet above mean sea level, and periods of intense and sustained rainfall are frequent. These conditions may appreciably increase the probability for turbidity-related effects from construction to affect or harm salmon and steelhead in the action area.

While the listed species are likely to be present during the this period, the abundance of fish is generally low during this period. Salmon rearing in the action area during construction may also be exposed to other stress factors, *e.g.*, 303 (d) parameters such as toxics, that in combination with increases in turbidity, are likely to increase physiological stress with the potential for reduced survival.

The Fort James Corporation has proposed to isolate the in-water work area with a steel sheet pile cofferdam. Once the cofferdam is in place, water quality effects to surrounding waters during excavation are likely to attenuate to background levels. Cofferdam removal is likely to result in a temporary pulse of sediment increasing turbidity. An initial short-term turbidity plume is likely to persist for a period of hours after the cofferdam is removed. The initial turbidity plume is likely to attenuate to background levels at a distance not to exceed 250 feet upriver or down river from the excavated bank face.

A long-term turbidity plume may persist for a period of weeks to months until vegetation has established on the bank face, or soil beneath the riprap, sufficient to hold excavated soils in place. The extent of any long-term turbidity plume is likely to remain near the wetter perimeter and, attenuate to background levels at a distance not to exceed 50 feet from the excavated bank face, and is unlikely to be at a concentration where harm to listed fish would occur once initial adjustments have occurred (approximately one month). The proposed conservation measures are likely to reduce the intensity of some of the adverse effects from construction activities in or beside the river and on listed fish, although there is uncertainty due to limited details provided on the conservation measures.

IV. Water Quality - Pollutants

Operation of heavy equipment requires the use of fuel, lubricants, coolants, *etc.*, which if spilled into a waterbody, could injure or kill aquatic organisms. Petroleum-based contaminants, such as fuel, oil, and some hydraulic fluids, contain harmful polycyclic aromatic hydrocarbons.

The Columbia River, river mile 35 to 101.5, is water quality limited for DDE, DDT, arsenic, and PCB. These pollutants occur in both the water column and sediments of the riverbed. Since these pollutants are on the DEQ 303(d) list, this means that these pollutants are at concentrations that do not protect the beneficial uses (*e.g.*, salmonid fishes) from adverse effects. No information was provided regarding sediment characterization and chemical composition of the substrate in the action area. However, near-shore habitats in the lower Columbia River generally have a high percentage (40% to 75%) of silt and clay, therefore it is likely that contaminated sediments would be suspended during in-water excavation. For this analysis, the exposure potential is limited to contaminated sediments resuspended by construction activities that result from in-water work, *i.e.*, riverbank and riverbed excavation, cofferdam installation and removal, and pile installation.

The probability of contaminated sediments being resuspended during in-water activities is high, resulting in potential adverse effects including, but not limited to, impaired growth and reproduction, immune dysfunction, hormonal alterations, enzyme induction, neurotoxicity, disease susceptibility, and mutagenicity (Meador 2000). The probability that some salmon and steelhead may be exposed to contaminated sediments resuspended during in-water work ranges from low to high. While the probability of exposure ranges from low to high, the intensity and severity of such an effect is likely to be low, due largely to the short duration (hours) of contaminated sediments being suspended, and the size of the area (approximately 2664 square feet) being excavated.

The pathway with the highest probability for exposure is in-water excavation of the riverbed, which would occur within the cofferdam. Exposure is most likely to occur when the cofferdam is removed, releasing suspended sediments contained within the cofferdam into the Columbia River.

Juvenile salmon and steelhead abundance during the November 1 to February 28 in-water work window is generally low to moderate in the action area, which is likely to reduce the potential for a high percentage of fish to be exposed to any pollutant-pulse associated with in-water work. Therefore, while the probability exists that some fish may be exposed to resuspend DDE, DDT, arsenic, and PCB, it is unlikely that such an exposure would be of a intensity, severity, or duration that would result in harm to juvenile salmon and steelhead.

The proposed conservation measures include a hazardous materials containment measure, however, other than the proposal to use non-toxic and biodegradable hydraulic fluids for heavy equipment, the Corps provided no details regarding the measure to contain other hazardous materials (*e.g.*, petroleum, polluted water). Therefore the potential effectiveness of the proposed conservation measures to reduce adverse effects cannot be thoroughly evaluated due to the limited details provided.

V. Pile Installation-Hydro-Acoustic Effects

Pile-driving can cause intense temporary underwater sounds that may affect the behavior of salmon up to 1946 feet (NOAA Fisheries 2003). These hydro-acoustic effects can injure or kill salmonid fishes. Sound pressure waves in excess of 190 decibels (dB) may be fatal to fish, however 155 dB may be sufficient to stun, injure, or harass (*i.e.*, causing temporary behavioral changes such as elicitation of a startle response or behavior associated with stress) small fishes (Hastings 1995, 2003).

The type and intensity of the sounds produced during pile driving depend on a variety of factors, including, but not limited to, the type and size of the pile, the firmness of the substrate into which the pile is being driven, the depth of water and the type and size of the pile-driving hammer. Sound pressures are positively correlated with the size of the pile, as more energy is required to drive larger piles. Firmer substrates require more energy to drive piles, and produce more intense sound pressures. Sound attenuates more rapidly with distance from the source in shallow than in deep water (Rogers and Cox 1988).

Driving hollow steel piles with impact hammers produce intense, sharp spikes of sound which can easily reach levels that injure fishes. Vibratory hammers, on the other hand, produce sounds of lower intensity, with a rapid repetition rate. Sound waves or particles produced by impact hammers and those produced by vibratory hammers evoke different responses in fishes. When exposed to sounds which are similar to those of a vibratory hammer, fishes consistently displayed an avoidance response (Enger *et al*. 1993, Dolat 1997, Knudsen *et al*. 1997, Sand *et al*. 2000), and did not habituate to the sound, even after repeated exposure (Dolat 1997, Knudsen *et al*. 1997). Fishes may respond to the first few strikes of an impact hammer with a startle response. After these initial strikes, the startle response wanes and the fishes may remain within the field of a potentially-harmful sound (Dolat 1997). The differential responses to these sounds are due to the differences in the duration and frequency of the sounds.

Fishes respond to particle acceleration of 0.01 m/s^{-2} at infrasound frequencies. The response to infrasound is limited to the near-field in relation to the source (< 1 wavelength), and the fish must be exposed to the sound for several seconds (Enger *et al*. 1993, Knudsen *et al*. 1994, Sand *et al*. 2000). Impact hammers, however, produce such short spikes of sound, with so little energy in the infrasound range, that fishes fail to respond to the particle motion (Carlson *et al*. 2001). Thus, impact hammers may be more harmful than vibratory hammers for two reasons: First, they produce more intense pressure waves, and second, the sounds produced do not elicit an avoidance response in fishes, which will expose them for longer periods to the harmful sound pressures.

Pile installation is likely to lead to effects on salmonid fishes similar to those described above, but are likely to be intermittent and limited to a period of 5 to 10 hours per day during pile installation. The Corps did not provide information on the type of hammers to be used for pile installation, therefore, in the absence of information NOAA Fisheries draws the biologically conservative conclusion that pile installation is likely to result in some fish being injured or killed at a distance up to 1946 feet from the left bank of the Columbia River (river mile 42.25).

VI. River Bank Modification

Natural riparian and stream processes are adversely affected by streambank hardening (*e.g.*, riprap, rock revetments) (Bolton and Shellberg 2001). Bank hardening not only modifies the streambed and bank but, as its primary purpose, stops natural processes that maintain a functioning riparian stream system. Potential effects of bank hardening on riverine processes include stream channel simplification, altered hydraulic processes, constrainment of stream channels (reduced sinuosity), loss of native sediment recruitment, and elimination of shallow-water habitat.

As erosive forces affect different areas in a stream, and bank hardening occurs in response, the stream eventually may attain a continuous fixed alignment lacking habitat complexity (USACE 1977). Bank hardening may shift erosion points either upstream, due to headcutting, or downstream, due to transfer of stream energy. Bank hardening can also increase stream velocities, contributing to channel incision and streambank failure.

Although riprap can provide some habitat features used by salmonids, such as inter-rock space, increasing evidence shows that in comparison to natural banks, fish densities at rock riprap banks are reduced (Schmetterling 2001). This is true even when compared to actively eroding cut banks (Michny and Deibel 1986, Schaffter *et al.* 1983). The use of riprap either results in site characteristics that limit suitability for fish at various life stages (Beamer and Henderson 1998, Peters *et al.* 1998, Li *et al.* 1984, North *et al.* 2002), or perpetuates detrimental conditions that may restrict or limit fish production (Beamer and Henderson 1998, Li *et al.* 1984). Even when rock may contribute to habitat structure within an alluvial stream system, the beneficial biological response is of limited duration with greater variability (Schmetterling 2001, Beamer and Henderson 1998, Peters *et al.* 1998, Andrus *et al.* 2000). The use of riprap can disrupt flows, reduce food delivery and create difficult swimming for smaller fish (Michny and Deibel 1986, Schaffter *et al.* 1983). These effects can reduce the suitability of the habitat for salmonids, and reduce the likelihood that adverse effects from riprap can be mitigated over time.

The proposed bank hardening (installation of riprap) without the incorporation of large woody material or other bio-technical features that would promote complex littoral habitat is likely to adversely affect habitat functions similar to those described above, and similar to the effects described above under *Water Quality - Turbidity*.

VII. Long-Term Operations

Complete design specifications for the new water intake were not provided.[4] Operation of the proposed airburst cleaning system may startle listed fish near the tee-screen system, although this startle effect is unlikely to result in harm. While some low intensity effect from airburst operations may occur, this effect is likely to be discountable. Overall, based on preliminary design, operation, and maintenance specifications, effects to juvenile salmon and steelhead resulting from water withdrawal operations of 125 cfs or less, provided the tee-screen system is operated and maintained in a manner consistent with NOAA Fisheries juvenile fish screening criteria, are likely to be discountable.

[4] Final design and operation specifications have not been approved by NOAA Fisheries.

Effects on Critical Habitat
The essential features of critical habitat include adequate: (1) Substrate, (2) water quality, (3) water quantity, (4) water temperature, (5) water velocity, (6) cover/shelter, (7) food, (8) riparian vegetation, (9) space, and (10) safe passage conditions (see, citations in Table 1).

In-water, upland, and near-shore work is likely to temporarily reduce the conservation value of critical habitat within an area measuring 1946 feet from the left bank of the Columbia River at river mile 42.25, and the adjacent riparian zone. The essential features of critical habitat affected by construction activities are water quality, riparian vegetation, space, and safe passage. For water quality, space, and safe passage, the intensity and severity of the effect is likely to be small, the extent localized, and the duration short-term and intermittent, occurring over a period of 4 months. For riparian vegetation, the intensity is likely to be small and the extent localized to the upland area and a small reach of the riverbank where vegetation is removed, but may be long-term until riparian vegetation is reestablished and riparian functions (greater than 10 years) are restored.

Cumulative Effects

Cumulative effects are defined in 50 C.F.R. 402.02 as "those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation." NOAA Fisheries is not aware of any specific future non-Federal activities within the action area that would cause greater effects to listed species than presently occurs.

Conclusion

After reviewing the best available scientific and commercial information regarding the biological requirements and the status of SR fall-run Chinook salmon, SR spring/summer-run Chinook salmon, SR sockeye salmon, SR steelhead, LCR Chinook salmon, UCR spring-run Chinook salmon, UWR Chinook salmon, CR chum salmon, MCR steelhead, LCR steelhead, UWR steelhead, UCR steelhead, and LCR coho salmon (proposed for listing) considered in this Opinion, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, NOAA Fisheries' concludes that the action, as proposed, is not likely to jeopardize the continued existence of these species, and is not likely to destroy or adversely modify critical habitat for SR spring/summer Chinook salmon, SR fall-run Chinook salmon, and SR sockeye salmon.

These conclusions are based on the following considerations: (1) In-water construction (*i.e.*, excavation, cofferdam installation and removal, pile installation, and rock placement) and its potential effects (*i.e.*, harm and harassment of listed fish, temporary degradation of water quality) likely will occur intermittently over a period of 4 months, will occur for no more than 5 to 10 hours per day, and will be short-term, pulse-type effects; (2) effects to juvenile salmon and steelhead resulting from water withdrawal operations of 125 cfs or less, provided the tee-screen system is operated and maintained in a manner that is consistent with NOAA Fisheries juvenile fish screening criteria, are likely to be discountable; and (3) rock will be placed only within the original design footprint of the riverbank and the area revegetated with native riparian species.

Reinitiation of Consultation

Reinitiation of formal consultation is required and shall be requested by the Federal agency or by the Service, where discretionary Federal involvement or control over the action has been retained or is authorized by law and: (a) If the amount or extent of taking specified in the incidental take statement is exceeded; (b) If new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (c) If the identified action is subsequently modified in a manner that has an effect to the listed species or critical habitat that was not considered in the biological opinion; or (d) If a new species is listed or critical habitat designated that may be affected by the identified action (50 C.F.R. 402.16).

To reinitiate consultation, contact the Oregon State Habitat Office of NOAA Fisheries and refer to NOAA Fisheries number 2002/00948.

Incidental Take Statement

Section 9(a)(1) and protective regulations adopted pursuant to section 4(d) of the ESA prohibit the taking of listed species without a specific permit or exemption. Among other things, an action that harasses, wounds, or kills an individual of a listed species or harms a species by altering habitat in a way that significantly impairs its essential behavioral patterns is a taking (50 C.F.R. 222.102). Incidental take refers to takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 C.F.R. 402.02). Section 7(o)(2) exempts any taking that meets the terms and conditions of a written incidental take statement from the taking prohibition. However, the incidental take statement of this conference opinion does not become effective until NOAA Fisheries adopts this conference opinion as a biological opinion, after the listing is final.

Amount or Extent of Take

The proposed action covered by this Opinion is reasonably certain to result in incidental take of listed species because it includes activities that will harm, injure, or kill individuals of the ESUs that are likely to be present in the action area. However, information about the distribution and abundance of those individuals is not specific enough to quantify the amount of fish that are likely to be taken. In such circumstances, NOAA Fisheries uses the causal link established between the activity and a change in habitat conditions affecting the species to describe the extent of take as a numerical level of habitat disturbance.

When an amount of incidental take cannot be ascribed, NOAA Fisheries identifies an extent of incidental take. The extent of incidental take for this action includes four areas: (1) The area within the cofferdam measuring 24 feet wide by 111 feet long; (2) an area (radius) measuring up to 1946 feet from each steel pile during installation from hydro-acoustic effects; (3) an area measuring 150 feet down river and 100 feet upriver from riverbank modifications; and (4) an area measuring up to 250 feet upriver and down river from river mile 42.25 from turbidity-related effects.

Based on the analysis of effects, NOAA Fisheries expects sound pressure waves generated from pile driving to result in incidental take of some cohorts of rearing and migrating fish found in the action area. The scientific literature indicates that most of the species using this area would be migrating salmon and steelhead, and most juvenile and adult salmon and steelhead of the Columbia River Basin ESUs spend little time (hours to days) in the area affected by the proposed action, although sub-yearling and yearling Chinook and coho salmon rear in the lower Columbia River for extended periods (months). The hydro-acoustic effects from pile driving are likely to be at a frequency (100 to 400 Hz) or sound pressure level (at or greater than 155 dB) likely to injure or harm listed salmon and steelhead at a distance up to 1946 feet during pile installation. Therefore, pile driving is likely to incidentally take some listed juvenile salmon and steelhead.

While some fishes are likely to avoid areas of long-term, repeated disturbance, impact hammers do not elicit an avoidance response in fishes, therefore, fish may remain within the sound pressure wave field potentially exposing them to harmful sound wave pressure. Thus, NOAA Fisheries expects that a small percentage of juveniles within each sound wave pressure field will be incidentally taken during pile driving. Incidental take from pile driving is limited to a maximum of 12 piles. Installation of more than 12 piles would result in incidental take to occur beyond the extent exempted by this incidental take statement and the Corps would need to reinitiate consultation pursuant to 50 C.F.R. 402.16.

The analysis of effects also summarizes an increase in short-term turbidity plumes associated with riverbank and riverbed excavation, cofferdam installation and removal, pile installation, and rock placement. NOAA Fisheries expects localized turbidity plumes to result in some low level of incidental take of listed fishes, likely in the form of behavior modification.

The extent of habitat affected by the action are thresholds for reinitiating consultation. Should any of these limits be exceeded, the reinitiation provisions of this Opinion apply.

Reasonable and Prudent Measures

Reasonable and prudent measures are non-discretionary measures to avoid or minimize take that must be carried out by cooperators for the exemption in section 7(o)(2) to apply. The Corps has the continuing duty to regulate the activities covered in this incidental take statement where discretionary Federal involvement or control over the action has been retained or is authorized by law. The protective coverage of section 7(o)(2) may lapse if the Corps fails to exercise its discretion to require adherence to terms and conditions of the incidental take statement, or to exercise that discretion as necessary to retain the oversight to ensure compliance with these terms and conditions. Similarly, if any applicant fails to act in accordance with the terms and conditions of the incidental take statement, protective coverage may lapse. The following reasonable and prudent measures are necessary and appropriate to minimize the impact on listed species of incidental taking caused by take of listed species resulting from completion of the proposed action.

The following reasonable and prudent measures are necessary and appropriate to minimize take of listed species resulting from completion of the proposed action. These reasonable and prudent measures would also minimize adverse effects to critical habitat, if any.

The Corps shall:

1. Minimize incidental take from general construction by applying conditions to the proposed action that avoid or minimize adverse effects to water quality, riparian, and aquatic systems.

2. Ensure completion of a comprehensive monitoring and reporting program to confirm this Opinion is meeting its objective of minimizing take from the proposed action.

Terms and Conditions

To be exempt from the prohibitions of section 9 of the ESA, the Corps and its cooperators, including the applicant, if any, must comply with the following terms and conditions, that implement the reasonable and prudent measures described above. Partial compliance with these terms and conditions may invalidate this take exemption, result in more take than anticipated, and lead NOAA Fisheries to a different conclusion regarding whether the proposed action will result in jeopardy or the destruction or adverse modification of critical habitats.

1. To implement reasonable and prudent measure #1 (construction), the Corps shall ensure that:

    a. <u>Timing of in-water work</u>. All in-water is completed during the period between November 1 and February 28, unless otherwise approved in writing by NOAA Fisheries.
    b. <u>Cessation of work</u>. Project operations shall cease under high flow conditions that may result in inundation of the project area, except for efforts to avoid or minimize resource damage.
    c. <u>Pollution Control Plan</u>. A pollution control plan is prepared and carried out to prevent pollution related to construction operations. The plan shall contain the elements listed below, meet requirements of all applicable laws and regulations, and be available for inspection on request by NOAA Fisheries.
        i. A description of any hazardous products or materials that shall be used for the project, including procedures for inventory, storage, handling, and monitoring.
        ii. A spill containment and control plan with notification procedures, specific clean up and disposal instructions for different products, quick response containment and clean up measures that shall be available on the site,

proposed methods for disposal of spilled materials, and employee training for spill containment.

iii. A description of turbidity control measures.

d. Preconstruction activity. Before significant[5] alteration of the project area, the following actions shall be completed:

i. Emergency erosion controls. Ensure that the following materials for emergency erosion control are onsite:

(1) A supply of sediment control materials (*e.g.*, silt fence, straw bales).[6]

(2) An oil-absorbing, floating boom whenever surface water is present.

ii. Temporary erosion controls. All temporary erosion controls shall be in-place and appropriately installed downslope of project activity within the riparian area until site restoration is complete.

e. Heavy Equipment. Use of heavy equipment is restricted as follows.

i. Vehicle staging. Vehicles shall be fueled, operated, maintained, and stored as follows.

(1) Vehicle staging, cleaning, maintenance, refueling, and fuel storage shall take place in a vehicle staging area placed 150 ft or more from any stream, wetland, and mean higher high water (MHHW).

(2) Axillary fuel tanks stored at staging areas shall have containment measures in place at all times.

(3) All vehicles operated within 150 feet of any stream, waterbody, wetland, or MHHW shall be inspected daily for fluid leaks before leaving the vehicle staging area. Any leaks detected shall be repaired in the vehicle staging area before the vehicle resumes operation. Inspections shall be documented in a record that is available for review on request by NOAA Fisheries.

(4) All equipment operated below MHHW shall be cleaned before beginning operations below the bankfull elevation to remove all external oil and grease.

ii. Stationary power equipment. Any stationary power equipment (*e.g.*, generators, cranes) operated within 150 feet of any stream, waterbody, wetland, or MHHW shall be diapered to prevent leaks, unless otherwise approved in writing by NOAA Fisheries.

f. In-water work.

i. Cofferdam

(1) To minimize fish being trapped in the cofferdam, steel sheet piling for the cofferdam shall be installed starting from the pump station

---

[5] "Significant" means an effect can be meaningfully measured, detected or evaluated.

[6] When available, certified weed-free straw or hay bales must be used to prevent introduction of noxious weeds.

working toward the river, with the sheet pilings parallel to the flow of the river (Figure 2, revised application) being installed last.

g. Earthwork.

   i. Site stabilization. All disturbed areas shall be stabilized within 12 hours of any break in work unless construction will resume work within 7 days between June 1 and September 30, or within 2 days between October 1 and May 31.

   ii. Source of materials. Boulders, rock, woody materials and other natural construction materials used for the project shall be obtained outside the riparian area.

h. Site restoration. The riverbank, soils and vegetation disturbed by the project are cleaned up and restored as follows.

   i. Revegetation. Areas requiring revegetation shall be replanted before the first April 15 following construction with native woody species, *e.g.*, Sitka spruce, black cottonwood, western red cedar, coast willow, and twinberry.

   ii. Pesticides. No pesticide application is allowed, although mechanical or other methods may be used to control weeds and unwanted vegetation.

   iii. Fertilizer. No surface application of fertilizer shall occur within 50 feet of any stream channel.

i. Pile Driving.

   i. If substrate conditions are appropriate, vibratory hammers shall be used to drive piles. If substrate conditions are not appropriate, impact hammers may be used. Impact hammers require the use of a bubble curtain.

   ii. Drive each piling as follows to minimize the use of force and resulting sound pressure.

      (1) When impact drivers are used to install a pile, use the smallest driver and the minimum force necessary to complete the job. Use a drop hammer or a hydraulic impact hammer, whenever feasible and set the drop height to the minimum necessary to drive the piling.

      (2) When using an impact hammer to drive or proof steel piles, the following sound attenuation device shall be used to reduce sound pressure levels by at least 20 dB.

         (a) Surround the piling being driven with a confined bubble curtain (*e.g.*, a bubble ring surrounded by a fabric or metal sleeve) that will distribute air bubbles around 100% of the piling perimeter for the full depth of the water column.

         (b) Other sound attenuation devices as approved in writing by NOAA Fisheries.

2. To implement reasonable and prudent measure #2 (monitoring), the Corps shall ensure that:

   a. Implementation monitoring. Submit a monitoring report to NOAA Fisheries within 120 days of project completion describing the Corps' success meeting these terms and conditions. The monitoring report shall include the following information.

      i. Project identification.
         (1) Project name.
         (2) Corps contact person.
         (3) Starting and ending dates for work completed.
         (4) Photo of habitat conditions at the project site, before, during, and after project completion.[7]
            (a) Include general views and close-ups showing details of the new water intake supply pipe, the affected riverbank, and general project area, including pre and post construction.
            (b) Label each photo with date, time, project name, photographer's name, and a comment about the subject.

      ii. Work cessation. Dates work cessation was required due to high flows, if any.

      iii. Pollution and erosion control. A summary of pollution and erosion control inspections, including any erosion control failure, hazardous material spill, and correction effort.

      iv. Site preparation. Total cleared area, riparian and upland.

      v. Site restoration.
         (1) Finished grade slopes and elevations.
         (2) Planting composition and density.
         (3) Confirmation that 80% revegetation survival or 80% plant coverage (including both plantings and natural recruitment) have been achieved, invasive non-native vegetation is under control, and plantings are protected from wildlife damage and other harm.

      vii. Cofferdam.
      To monitor the impacts of incidental take, the area affected by the cofferdam (approximately 2664 square feet) shall be monitored daily for injured or dead fish.
         (1) If a injured or dead specimen of a threatened or endangered species is found, the finder must notify the Vancouver Field Office of NOAA Fisheries Law Enforcement at 360.418.4246. The finder must take care in handling of sick or injured specimens to ensure effective treatment, and in handling dead specimens to preserve

[7] Relevant habitat conditions may include characteristics of channels, eroding and stable streambanks in the project area, riparian vegetation, water quality, flows at base, bankfull and over-bankfull stages, and other visually discernable environmental conditions at the project area, and upstream and downstream from the project.

biological material in the best possible condition for later analysis of cause of death. The finder also has the responsibility to carry out instructions provided by Law Enforcement to ensure that evidence intrinsic to the specimen is not disturbed unnecessarily.

viii. Pile installation.
To monitor the impacts of incidental take, the number, type, diameter, type of hammer(s) used, and the amount of time required to install each pile is recorded.

ix. Turbidity.
To monitor the impact of incidental take, turbidity generated by construction activities shall be monitored at a fixed location 250 feet upriver and down river from the cofferdam (approximately river mile 42.25), and shall include a control station located at least 500 feet upriver.

(1) Turbidity shall be recorded in using a nephleometer and recorded in nephelometric turbidity units (NTU).

(2) Turbidity levels shall be recorded twice every hour during the initial phase of in-water construction (i.e., cofferdam installation and removal, and during river bank excavation and installation of riprap). Exception: Once the cofferdam is completely installed, turbidity monitoring is not required for work within the cofferdam. This exception is not valid if the cofferdam is discharging turbid water into the Columbia River. For cofferdam removal, turbidity monitoring shall continue for a period of one hour after the cofferdam has been removed.
Samples shall be collected from a depth of one foot below surface elevation.

(3) A copy of all turbidity measurements recorded to include date, time, and NTU.

b. Submit monitoring report to:

NOAA Fisheries
Oregon State Habitat Office
Attn: 2002/00948
525 NE Oregon Street, Suite 500
Portland, OR 97232-2778

MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

The consultation requirements of section 305(b) of the MSA direct Federal agencies to consult with NOAA Fisheries on all actions, or proposed actions, that may adversely affect essential fish habitat (EFH). Adverse effects include the direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects to EFH may result from actions occurring within EFH or outside EFH, and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 C.F.R. 600.810). Section 305(b) also requires NOAA Fisheries to recommend measures that may be taken by the action agency to conserve EFH.

The Pacific Fishery Management Council designated EFH for groundfish (PFMC 1998a), coastal pelagic species (PFMC 1998b), and Chinook salmon, coho salmon, and Puget Sound pink salmon (PFMC 1999). The proposed action and action area for this consultation are described in the Introduction to this document. The action area includes areas designated as EFH for various life-history stages of Chinook and coho salmon Pacific Coast salmon (PFMC 1999), and starry flounder (PFMC 1998a).

The effects of the proposed action on EFH are largely water quality-related due to temporary increases in turbidity, resuspension of contaminated sediments, and temporary disturbance of near-shore habitat.

EFH Conservation Recommendations

NOAA Fisheries believes that the following conservation measures are necessary to avoid, mitigate, or offset the impact that the proposed action has on EFH.

Term and conditions 1c, 1d, 1e, 1g, and 1h of the Opinion.

Statutory Response Requirement

Federal agencies are required to provide a detailed written response to NOAA Fisheries' EFH conservation recommendations within 30 days of receipt of these recommendations. The response must include a description of measures proposed to avoid, mitigate, or offset the adverse affects that the activity has on EFH. In the response is inconsistent with the EFH conservation recommendations, the response must explain the reasons for not following the recommendations, including the scientific justification for any disagreements over the anticipated effects of the proposed action and the measures needed to avoid, minimize, mitigate, or offset such effects.

Supplemental Consultation

The Corps must reinitiate EFH consultation with NOAA Fisheries if the proposed action is substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for NOAA Fisheries' EFH conservation recommendations [50 C.F.R. 600.920(l)].

DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

Section 515 of the Treasury and General Government Appropriations Act of 2001 (Public Law 106-554) ("Data Quality Act") specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the Opinion addresses these Data Quality Act (DQA) components, documents compliance with the DQA, and certifies that this Opinion has undergone pre-dissemination review.

Utility: This ESA section 7 consultation on the Fort James Water Intake Project, in Clatsop County, Oregon, concluded that the action will not jeopardize the continued existence of SR fall-run Chinook salmon, SR spring/summer-run Chinook salmon, SR sockeye salmon, SR steelhead, LCR Chinook salmon, UCR spring-run Chinook salmon, UWR Chinook salmon, Columbia River chum salmon, MCR steelhead, LCR steelhead, UWR steelhead, UCR steelhead, and LCR coho salmon (proposed for listing). Therefore, the Corps may authorize that action. Pursuant to the MSA, NOAA Fisheries provided the Corps with conservation recommendations to conserve EFH.

The intended users of these consultations are the Corps and the applicant. The Fort James Corporation and the American public will benefit from the consultation.

Individual copies were provided to the above-listed entities. This consultation will be posted on the NOAA Fisheries NW Region web site (http://www.nwr.noaa.gov). The format and naming adheres to conventional standards for style.

Integrity: This consultation was completed on a computer system managed by NOAA Fisheries in accordance with relevant information technology security policies and standards set out in Appendix III, "Security of Automated Information Resources," Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

Objectivity:

Information Product Category: Natural Resource Plan.

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including the NOAA Fisheries ESA Consultation Handbook, ESA Regulations, 50 C.F.R. 402.01 *et seq*., and the MSA implementing regulations regarding EFH, 50 C.F.R. 600.920(j).

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the literature cited section. The analyses in this Opinion/EFH consultation contain more background on information sources and quality.

Referencing: All supporting materials, information, data and analyses are properly referenced, consistent with standard scientific referencing style.

Review Process: This consultation was drafted by NOAA Fisheries staff with training in ESA and MSA implementation, and reviewed in accordance with Northwest Region ESA quality control and assurance processes.

LITERATURE CITED

Andrus, C., J. Gabriel, and P. Adamus. 2000. Biological Evaluation of the Willamette River and McKenzie River Confluence Area. Technical Report. McKenzie Watershed Council. Eugene, Oregon.

Berg, L. 1983. Effects of short-term exposure to suspended sediments on the behavior of juvenile coho salmon. Master's Thesis. University of British Columbia, Vancouver, B.C. Canada.

Beamer, E.M., R.A. Henderson. 1998. Juvenile Salmonid Use of Natural and Hydromodified Streambank Habitat in the Mainstem Skagit River, Northwest Washington. Corps of Engineers, Seattle District. Seattle Washington, September 1998.

Bisson, P.A. and Bilby, R.E. 1982. Changes in territorial, gill-flaring and feeding behavior in juvenile coho salmon following short-term pulses of suspended sediments. Canadian Journal of Fisheries and Aquatic Sciences. 42:1410-1417.

Bolton, S. and J. Shellberg. 2001. Ecological Issues in Floodplains and Riparian Corridors. White Paper: Aquatic Habitat Guidelines. Washington Department of Fish and Wildlife, Washington Department of Ecology, and Washington Department of Transportation. Olympia, Washington.

BRT (West Coast Salmon Biological Review Team). 2003. Updated status of Federally listed ESUs of West Coast salmon and steelhead. U. S. Department of Commerce, National Marine Fisheries Service, Northwest Fisheries Science Center and Southwest Fisheries Science Center (July 2003). http://www.nwr.noaa.gov/AlseaResponse/20040528/brtusr.html

Busby, P. J., T. C. Wainwright, G. J. Bryant, L. Leirheimer, R. S. Waples, F. W. Waknitz, and I. V. Lagomarsino. 1996. Status review of west coast steelhead from Washington, Idaho, Oregon, and California. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-NWFSC-27. 281 p.

Carlson, T., G. Ploskey, R. L. Johnson, R. P. Mueller and M. A. Weiland. 2001. Observations of the behavior and distribution of fish in relation to the Columbia River navigation channel and channel maintenance activities. Review draft report to the Portland District Corps of Engineers prepared by Pacific Northwest National Laboratory, Richland, Washington. 35 p.

Chapman, D., C. Pevan, T. Hillman, A. Giorgi, and F. Utter. 1994. Status of summer steelhead in the mid-Columbia River. Don Chapman Consultants, Inc., Boise, Idaho.

Cooney, T.D. 2002. UCR steelhead and spring Chinook salmon quantitative analysis report. Part 1: Run reconstructions and preliminary assessment of extinction risk. National Marine Fisheries Service, Hydro Program, Technical Review Draft, Portland, Oregon.

Dolat, S.W. 1997. Acoustic measurements during the Baldwin Bridge demolition (final, dated March 14, 1997). Prepared for White Oak Construction by Sonalysts, Inc, Waterford, CT.. 34 p. + appendices. Enger *et al*. 1992.

Enger, P.S., H.E. Karlsen, F.R. Knudsen, and O. Sand. 1993. Detection and reaction of fish to infrasound. Fish Behaviour in Relation to Fishing Operations., 1993, pp. 108-112, ICES marine science symposia. Copenhagen vol. 196.

Evermann, B.W. 1895. A preliminary report upon salmon investigations in Idaho in 1894. U.S. Fish Commission Bulletin15:253-284.

Fish Passage Center. 2003. Fish passage center annual report–2002. Fish passage center, Columbia River Basin fish and wildlife authority, Portland, OR.

Groot, C. and L. Margolis. 1991. Pacific Salmon Life Histories. UBC Press, Vancouver, Canada. 564 p.

Fulton, L.A. 1968. Spawning areas and abundance of Chinook salmon, *Oncorhynchus tshawytscha*, in the Columbia River basin–past and present. U.S. Fish and Wildlife Service, Special Scientific Report, Fisheries 571:26.

Fulton, L.A. 1970. Spawning areas and abundance of steelhead trout and coho, sockeye, and chum salmon in the Columbia River basin–past and present. U.S. Fish and Wildlife Service, Special Scientific Report, Fisheries 618.

Gammon, J.R. 1970. The effects of inorganic sediment on stream biota. Environmental Protection Agency, water quality office, water pollution control research series 18050DWCI2/70.

Hastings, M.C. 2002. Clarification of the meaning of sound pressure levels and the known effects of sound on fish. August 26, 2002; revised August 27, 2002. pp 8.

Howell, P., K. Jones, D. Scarnecchia, L. LaVoy, W. Knedra, and D. Orrmann. 1985. Stock assessment of Columbia River anadromous salmonids, 2 volumes. Final Report to Bonneville Power Administration, Portland, Oregon (Project 83-335).

Jackson, P.L. 1993. Climate. P. 48-57 in: Jackson, P.L and A. J. Kimerling (eds.). Atlas of the Pacific Northwest. Oregon State University Press, Corvallis, Oregon.

Johnson, O.W., W.S. Grant, R.G. Cope, K. Neely, F.W. Waknitz, and R.S. Waples. 1997. Status review of chum salmon from Washington, Oregon, and California. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-32. 280 p.

Knudsen, F.R., C.B. Schreck, S.M. Knapp, P.S. Enger, and O. Sand. 1997. Infrasound produces flight and avoidance responses in Pacific juvenile salmonids. Journal of Fish Biology, 51:824-829.

Li, H. W.; C. B. Schreck, and R. A. Tubb. 1984. Comparison of Habitats near Spur Dikes, Continuous Revetments, and Natural Banks for Larval, Juvenile, and Adult Fishes of the Willamette River. Oregon Cooperative Fishery Research Unit Department of Fisheries and Wildlife, Oregon State University. Water Resources Research Institute, Oregon State University, Corvallis, Oregon 1984.

Longmuir, C., and T. Lively. 2001. Bubble curtain systems for use during marine pile driving. Report by Fraser River Pile & Dredge Ltd., New Westminster, British.Columbia. 9 pp.

Marr, J.C. 1943. Age, length, and weight studies of three species of Columbia River salmon (*Oncorhynchus keta, O. gorbuscha and O. kisutch*). Stanford Ichthyological Bulletin 2:157-197.

Matthews, G. M., and R. S. Waples. 1991. Status review for Snake River spring and summer Chinook salmon. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-200. 75 p.

Mattson, C.R. 1948. Spawning ground studies of Willamette River spring Chinook salmon. Fish commission of Oregon research briefs 1(2):21-32.

Meador, J. 2000. An analysis in support of sediment quality guidelines PCBs for the protection of threatened and endangered salmonids. Internal report, NMFS. Memo from Tracy K. Collier, through John E. Stein, to Steven Landino. September, 2000. Northwest Fisheries Science Center, NMFS, NOAA, Seattle.

McClure, M., B. Sanderson, E. Holmes, C. Jordan, P. Kareiva, and P. Levin. 2000. Revised Appendix B of standardized quantitative analysis of the risks faced by salmonids in the Columbia River basin. National Marine Fisheries Service, Northwest Fisheries Science Center, Seattle, Washington.

McElhany, P., M. Ruckleshaus, M. J. Ford, T. Wainwright, and E. Bjorkstedt. 2000. Viable Salmon Populations and the Recovery of Evolutionarily Significant Units. U. S. Department of Commerce, National Marine Fisheries Service, Northwest Fisheries Science Center, NOAA Technical Memorandum NMFS-NWFSC-42. 156 p. http://www.nwfsc.noaa.gov/publications/techmemos/tm42/tm42.pdf

McKernan, D.L., and C.R. Mattson. 1950. Observations on pulp and paper effluents and the probable effects of this pollutant on the fisheries resources of the Willamette River in Oregon. Fish Commission of Oregon, Fish Commission Research Briefs 3(1):14-21.

Michny, F., and R. Deibel. 1986. Sacramento River Chico Landing to Red Bluff Project 1985 Juvenile Salmon Study. US Fish and Wildlife Service Sacramento, California. US Army Corps of Engineers.

Myers, J.M., R.G. Kope, G.J. Bryant, D. Teel, L.J. Lierheimer, T.C. Wainwright, W.S. Grant, F.W. Waknitz, K. Neely, S.T. Lindley, and R.S. Waples. 1998. Status review of Chinook salmon from Washington, Idaho, Oregon, and California. NMFS-NWFSC-35. U.S. Dept. Commer., NOAA Technical Memorandum. 443 p.

Myers, J. M., C. Busack, D. Rawding, and A. Marshall. 2002. Identifying historical populations of chinook and chum salmon and steelhead within the lower Columbia River and upper Willamette River evolutionary significant units. Draft report to the co-managers from the Willamette/Lower Columbia River Technical Recovery Team (10 May 2002).

NMFS (National Marine Fisheries Service). 1996a. Supplemental report of the Biological Review Team on central California coast coho salmon. Memorandum from M. Schiewe to W. Stelle, dated 17 October, 1996, 4 p. Available from Environmental and Technical Services Division, National Marine Fisheries Service, 525 NE Oregon Street, Portland, Oregon 97232.

NMFS (National Marine Fisheries Service). 1996b. Status review update for coho salmon from Washington, Oregon, and California. Draft document prepared by the West Coast Coho salmon Biological Review Team, 20 December 1996, 47 p. plus tables, figures and appendices.

NOAA Fisheries (National Marine Fisheries Service). 2003. Endangered Species Act section 7 programmatic formal consultation and Magnuson-Stevens fishery conservation and managment act essential fish habitat consultation for the oil spill response activities conducted under the Northwest Area Contingency Plan (NWACP). National Marine Fisheries Service, Seattle, Washington.

NOAA (National Marine Fisheries Service). 2000a. Biological Opinion. Reinitiation of Consultation on Operation of the Federal Columbia River Power System, Including the Juvenile Fish Transportation Program, and 19 Bureau of Reclamation Projects in the Columbia Basin. National Marine Fisheries Service, Northwest Region, Seattle, WA.

Noggle, C.C. 1978. Behavioral, physiological and lethal effects of suspended sediment on juvenile salmonids. [Thesis] Seattle: University of Washington.

NRC (National Research Council). 1996. Upstream—Salmon and Society in the Pacific Northwest. National Academy Press, Washington, D.C. 452 p.

ODFW (Oregon Department of Fish and Wildlife). 1998. Briefing paper–Lower Columbia River Chinook ESU. ODFW, Portland. October 13.

Peters, R. J., B. R. Missildine, and D. L. Low. 1998. Seasonal Fish Densities Near River Banks Treated with Various Stabilization Methods. US Fish and Wildlife Service, Lacey, Washington.

Phelps, S.R., L.L. LeClair, S. Young, and H.L. Blankenship. 1994. Genetic diversity patterns of chum salmon in the Pacific Northwest. Canadian J. Fish. Aquat. Sci. 51 (Suppl. 1):65-83.

PFMC (Pacific Fishery Management Council). 1999. Amendment 14 to the Pacific Coast Salmon Plan. Appendix A: Description and Identification of Essential Fish Habitat, Adverse Impacts and Recommended Conservation Measures for Salmon. Pacific Fishery Management Council, Portland, Oregon (March 1999). http://www.pcouncil.org/salmon/salfmp/a14.html

PFMC (Pacific Fishery Management Council). 1998a. Final Environmental Assessment/ Regulatory Review for Amendment 11 to the Pacific Coast Groundfish Fishery Management Plan. Pacific Fishery Management Council, Portland, Oregon (October 1998). http://www.pcouncil.org/groundfish/gffmp/gfa11.html

PFMC (Pacific Fishery Management Council). 1998b. The coastal pelagic species fishery management plan: Amendment 8. Portland, Oregon.

Reisenbichler, R.R., J.D. McIntyre, M.F. Solazzi, and S.W. Landino. 1992. Genetic variation in steelhead of Oregon and northern California. Trans. Am. Fish. Soc. 121:158-169.

Rich, W.H. 1942. The salmon runs of the Columbia River in 1938. Fisheries Bulletin 50:103-147.

Rogers, P.H. and M. Cox. 1988. Underwater sound as a biological stimulus. pp. 131-149 *in*: Sensory biology of aquatic animals. Atema, J, R.R. Fay, A.N. Popper and W.N. Tavolga (eds.). Springer-Verlag. New York.

Sand, O., P.S. Enger, H.E. Karlsen, F. Knudsen, T. Kvernstuen. 2000. Avoidance responses to infrasound in downstream migrating European silver eels, Anguilla anguilla. Environmental Biology of Fishes, 57:327-336.

Salo, E.O. 1991. Life history of chum salmon, *Oncorhynchus keta*. P. 231-309 in: C. Groot and L. Margolis, eds. Pacific salmon life histories. University of British Columbia Press, Vancouver, B.C.

Schaffter, R. G., P. A. Jones, and J. G. Karlton. 1983. Sacramento River and Tributaries Bank Protection and Erosion Control Investigation Evaluation of Impacts on Fisheries. California Department of Fish and Game. US Army Corps of Engineers DACWO 5-80-C-0110. Sacramento, California.

Schmetterling, D. A., C. G. Clancey, and T. M. Brandt. 2001. Effects of riprap bank reinforcement on stream salmonids in the western United States. Fisheries Vol. 26. 7:6-13.

Schreck, C.B., H.W. Li, R.C. Jhort, and C.S. Sharpe. 1986. Stock identification of Columbia River Chinook salmon and steelhead trout. Final report to Bonneville Power Administration, Portland, Oregon (Project 83-451).

Spence, B.C., G.A. Lomnicky, R.M. Hughes, and R.P. Novitzki. 1996. An ecosystem approach to salmonid conservation. TR-4501-96-6057. ManTech Environmental Research Services Corp., Corvallis, Oregon. 356 pp.

Stotz, T. and J. Colby. 2001. January 2001 dive report for Mukilteo wingwall replacement project. Washington State Ferries Memorandum. 5 pp. + appendices.

Thomas, D.W. 1983. Changes in the Columbia River estuary habitat types over the past century. Columbia River estuary study taskforce (CREST), Columbia River estuary data development program, Astoria, Oregon. 51 p.

WDF (Washington Department of Fisheries), WDW (Washington Department of Wildlife), and WWTIT (Western Washington Treaty Indian Tribes). 1993. Washington state salmon and steelhead stock inventory (SASSI), 1992. WDF, WDW, and WWTIT, Olympia.

WDFW (Washington Department of Fish and Wildlife). 2000. Chum salmon: Columbia River chum salmon. Washington Department of Fish and Wildlife, Olympia, WA. Available online at: <http://www.wa.gov/wdfw/fish/chum/chum-7.htm>

Waples, R.S., R.P. Jones, Jr., B.R. Beckman, and G.A. Swan. 1991a. Status review for Snake River fall Chinook salmon. U.S. Department of Commerce, NOAA Tech. Memo. NMFS F/NWC-201. 73 p.

Waples, R. S., O.W. Johnson, and R.P. Jones, Jr. 1991b. Status review for Snake River sockeye salmon. U.S. Department of Commerce, NOAA Technical Memorandum NMFS F/NWC-195. Prepared by the National Marine Fisheries Service, Northwest Fisheries Science Center, Seattle, WA. 14 p.

Zhou, S. and M. Chilcote. 2003. Stock assessment and population viability of Clackamas River coho salmon. Oregon Department of Fish and Wildlife Fish Division Information Report; Portland, Oregon. 35 p.